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AUTHOR McCoy, Leah P.
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ABSTRACT

Two groups of elementary school students were tested and compared on learning style perceptual preference. One group was comprised of 11 students identified as being in need of remedial instruction in mathematics. The other group consisted of eight average/above average students experiencing slight or no difficulties in mathematics. Grade levels ranged from 3 through 6. Focus was on assessing the use of concrete materials in mathematics instruction, comparing the perceptual preferences of mathematically-deficient and average/above average elementary school students, and using this information to make recommendations for instruction. Results indicate that the regular students preferred an auditory or visual mode of learning, and the remedial students preferred a kinesthetic mode. There was no difference in preference for tactile mode. A survey of 24 teachers indicated that 83% used concrete materials (visual or auditory instructional methods) only sometimes. It is concluded that the remedial students would benefit from more diverse instructional activities. The results strongly support the use of concrete manipulatives and related activities. (Author/TJH)

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Perceptual Preferences of Mathematically Deficient Elementary Students: Implications for Instruction

Leah P. McCoy

Indiana University at South Bend

Running Head: PERCEPTUAL PREFERENCES

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Perceptual Preferences of Mathematically Deficient Elementary Students: Implications for Instruction

Abstract

Two groups of elementary school students were tested and compared on learning style perceptual preference. One group was comprised of students identified as being in need of remedial instruction in mathematics. The other group consisted of regular students. Results indicated that the regular students preferred an auditory or visual mode of learning, and the remedial students preferred a kinesthetic mode. There was no difference in preference for tactile mode. A survey of teachers indicated that most of them used concrete materials only "sometimes." The conclusion was that the remedial students would benefit from more diverse instructional activities.

Perceptual Preferences of Mathematically Deficient Elementary Students: Implications for Instruction

The most recent National Assessment of Educational Progress results reveal that a number of elementary students do not perform adequately on standardized mathematics tests (Dossey, Mullis, Lindquist, & Chambers, 1988; Carpenter, Lindquist, Brown, Kouba, Silver, & Swafford, 1988). There is a great need for identification of the causes of mathematics learning problems and for discussion of teaching strategies to reduce them.

According to Bloom (1976), school learning is a function of student characteristics, instruction, and learning outcomes. Further, it is likely that there is a strong interaction between student characteristics and instruction, and that this interaction largely determines learning outcomes.

Instructional methods in elementary mathematics vary, but the literature strongly recommends the use of concrete manipulatives in elementary mathematics instruction (e.g. National Council of Teachers of Mathematics, 1980, 1987). It is suggested that the student must experience the mathematics to understand it. This recommendation is based on the theories of cognitive psychologists which suggest that the use of concrete representations of abstract mathematical concepts will help a student to internally construct the concept and, therefore,

learn it (Brownell, 1935; Bruner, 1977; Dienes, 1960; Piaget, 1952; Skemp, 1971).

A number of activities have been suggested to utilize manipulative materials to illustrate basic operations (counters, unifix cubes), place value (base ten blocks, Cuisennaire rods) and other mathematical concepts (Heddens, 1986; Kennedy, 1986; Lewis, 1985; Tucker, 1989). Research has shown that use of manipulatives improves mathematics achievement (Hynes, 1986; Kennedy, 1986; Suydam & Higgins, 1977). Further research has found that concrete manipulative experiences are particularly beneficial for remedial students (Moser, 1986; Thornton & Wilmont, 1986). Other studies, however, have found that many elementary mathematics teachers use concrete materials sparingly, if at all (Gilbert & Bush, 1988; Scott, 1983; Suydam, 1986).

Considerable attention has also been given to student characteristics and their interaction with instruction. Dunn, Dunn, and Price (1978) designed an instrument (the Learning Style Inventory) to determine components of a student's "learning style." This measure consists of 24 subscales to assess the student's preferred learning style. The student is said to learn best if the instruction is matched to the preferred learning style (Dunn, Dunn & Price, 1979).

Marcus (1979) attempted to describe the learning styles of students, and concluded that they had varied learning styles. Smith and Holiday (1987) compared the learning styles of students identified as having low, average, or high achievement on a

standardized basic skills battery. They found differences in the area of physical characteristics, particularly in perceptual preference. Students' preferences for auditory, visual, tactile, and kinesthetic presentation were studied, and differences were found in the visual preferences of students of different achievement levels.

Thus, we have evidence that there is an interactive relationship of student characteristics, instructional methods, and achievement. We have evidence that concrete manipulative models are effective in mathematics instruction, particularly in remediation. We have evidence that students vary in perceptual preference. We do not have empirical evidence to illustrate the particular relationship of learning style, use of manipulative materials, and achievement of mathematics students.

The purpose of this study was to assess the use of concrete materials in mathematics instruction, to compare the perceptual preferences of elementary students who had been identified as mathematically deficient with students whose mathematics achievement was average or above-average, and to use this information to make recommendations for instruction.

Methods

Subjects in this study were eleven students from two local public schools enrolled at a university remedial mathematics clinic (remedial group), and eight controls who were selected

from the same two schools and were experiencing no difficulties in mathematics (regular group). The remedial students had been identified by the regular teacher and the parents as needing remediation in mathematics. All clients from the two target schools in one session of the clinic were included in the sample. The control students were randomly selected from the students in the two schools who received satisfactory marks in mathematics. Grade levels ranged from three through six.

Use of manipulative materials for instruction was assessed with a brief questionnaire for all the teachers at the two schools (to take into account students' past experiences as well as the current school year). Teachers were given examples of concrete materials and asked if they used them often, sometimes, or never.

Selected learning style factors were assessed with the Learning Style Inventory (LSI) (Dunn, Dunn & Price, 1978). Selected subtests were administered in an interview format to the participants. The subtests included were the four dealing with perceptual preferences: auditory, visual, tactile, and kinesthetic. They consisted of six to fifteen true or false items. Scores indicated the degree to which the child preferred that mode.

Analysis involved two-sample t-tests, adjusted for unequal variances, to evaluate the differences in the perceptual preferences of the remedial and the regular students. Additionally, the percentages of teachers reporting levels of

concrete manipulative use were examined.

Results and Conclusions

Results of the teacher questionnaire answered by 24 teachers revealed that 4 percent of the teachers (n = 1) NEVER used manipulatives, 83 percent of the teachers (n = 20) SOMETIMES used manipulatives, and 13 percent of the teachers (n = 3) OFTEN used manipulatives. Thus, most of the teachers in these two schools used concrete manipulative materials only sometimes. Therefore, it may be concluded that they used traditional visual and auditory activities.

Means and standard deviations of the perceptual preference subscales for the two groups are presented in Table 1. Results

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Insert Table 1 here

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of the two-sample t-tests indicate that the remedial and regular groups were different in preference for auditory mode ($t(17) = -3.10$, $p < .01$), for visual mode ($t(17) = -3.97$, $p < .01$), and for kinesthetic mode ($t(17) = 3.00$, $p < .01$). There was no significant difference in preference for tactile mode ($t = 1.33$, $p > .05$).

These results indicate that the regular students had a significantly stronger preference for an auditory or visual mode

than the remedial students. The remedial students preferred a kinesthetic mode significantly more. And there was no difference between the remedial and regular groups in preference for a tactile mode.

When considered in light of the finding that most teachers at the sample schools use visual or auditory instructional methods, these results offer important information about a possible cause of mathematical difficulty. The students who had satisfactory achievement in mathematics were significantly more likely than the remedial group to express a preference for auditory or visual mode, and as likely to prefer a tactile mode. This implies that the regular group was able to work in a variety of perceptual modes, whereas the remedial group was less likely to be able to function well in auditory or visual mode. The remedial group was more likely to prefer kinesthetic mode, but there is no indication that this affected achievement. Thus, it may be concluded that one contributing cause of mathematical difficulty is a "mis-match" in the perceptual preference of the student and the usual mode of instruction of the teacher.

Educational Implications

While past research has indicated that most students learn best through a variety of modes (Dunn, Dunn & Price, 1978; Marcus, 1979; Smith & Holiday, 1987), none of these studies involved a sample identified as mathematically deficient.

The present study found that the remedial mathematics students were more likely than the regular students to prefer a kinesthetic mode and as likely as the regular students to prefer a tactile mode. The regular students, on the other hand, were more likely than the remedial students to prefer an auditory or visual mode. Since most of the teachers indicated that they did not often use manipulative materials (and thus used auditory or visual modes), is appears that the learning style preference of the remedial students is not matched by classroom mathematics instruction. Dunn, Dunn and Price (1979) strongly recommend that the student and the teaching approach be properly matched for maximum learning.

Methods of teaching elementary mathematics are currently in a state of change (Post, 1988). The traditional auditory or visual lecture/workbook practice format with emphasis on computation is no longer recommended. The learning theories of Bruner (1977) and Dienes (1971) are slowly becoming more predominant. There is an increased emphasis on the use of concrete manipulatives to introduce concepts and form a basis for later pictorial and symbolic activities (Kennedy, 1986; Moser, 1986; National Council of Teachers of Mathematics, 1987).

The results of this study strongly support the use of concrete manipulatives and related activities. Students who were unsuccessful in learning mathematics were less likely than their successful peers to prefer auditory or visual modes, which were the modes utilized by their teachers. Their past mathematics

experiences had not included a large number of manipulative models, and this may have been a contributing factor in their poor mathematics performance. Therefore, it is recommended that elementary mathematics instruction include a variety of concrete manipulative activities. This is especially important for students who are experiencing difficulty in learning mathematics and may not learn well auditorily or visually.

This study involved a relatively small sample and was limited to two schools. However, the results indicate a need for diversity in instructional methods. Clearly, the remedial students were low achievers, and the lack of concrete manipulative experiences seems a likely cause. Further research should examine this relationship more closely. For example, it would be interesting to study the effect of remedial instruction specifically designed for the child's preferred learning styles.

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Table 1.

Perceptual Preferences of Remedial and Regular Groups.

	Remedial[a]		Regular[b]		
	M	SD	M	SD	t
VARIABLE					
Auditory Preference	12.18	2.64	14.88	0.99	-3.10*
Visual Preference	11.00	1.95	13.75	1.04	-3.97*
Tactile Preference	5.38	0.92	4.75	1.04	1.33
Kinesthetic Preference	7.64	1.29	5.88	1.25	3.00*

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[a] $n = 11$. [b] $n = 8$.

* $p < .01$.